35966 Intake
R4-NC

Progress Energy

File: 12575

November 11, 2003

Tetra Tech, Inc.
c/o Kelly Meadows
10306 Eaton Place
Suite 340
Fairfax, VA 22030

Progress Energy Carolinas, Inc.
Roxboro Electric Generating Plant

Dear Mr. Meadows:

On November 3, 2003, Progress Energy Carolinas, Inc., received a request from the Environmental Protection Agency to provide you a copy of the studies referenced in the *Detailed Industry Questionnaire: Phase II Cooling Water Intake Structures* for the subject facility. The request referenced a study at a plant in West Virginia. We believe this reference is in error and the correct study is the Hyco Reservoir Environmental Report that was listed in Section D of the Questionnaire. Transmitted with this letter are pertinent excerpts of the Report.
Just as a note, the *Hyco Reservoir Environmental Report 1979-1980 Volume III Biological and Chemical Studies* Report page 7-29 section 7.7 Impingement indicates Unit 3 has no screens. This is incorrect. Screens were installed on Unit 3 in 1996 and this information is reflected in our response to the 1998-*Detailed Industry Questionnaire: Phase II Cooling Water Intake Structures*.

If you have any questions regarding this material please contact Fred Holt at (919) 362- 3558, fred.holt@pgnmail.com.

Sincerely,

Cecil E. Rowland

Larry E. Hatcher Jr

Plant Manager

Progress Energy Carolinas, Inc.
Roxboro Steam Plant
1700 Dunnaway Road
Semora, NC 27343

35966 Intake
R4-NC

Attachments:
Cover Page – *Hyco Reservoir Environmental Report 1979 – 1980 Volume I – Executive Summary*

Pages 3, 4, 12, and 24 of Summary

Cover Page - *Hyco Reservoir Environmental Report 1979 – 1980 Volume III Biological and Chemical Studies*

Pages 7-28, 7-29, 7-30, 7-53, 7-58, 7-59, 7-60, 7-61, 7-62, and 7-98 of Volume III.

cc: John Fox, USEPA, Office of Water, Mail Code 4303T, Ariel Rios Building, 1200 Pennsylvania Avenue, N.W. , Washington, DC 20460; w/o attachments

HYCO RESERVOIR

ENVIRONMENTAL REPORT

1979-1980

Volume I - Executive Summary

June 1981

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sectional depths of the reservoir vary from less than 1 meter to 10 meters (<3 to 32 feet); average reservoir depth is 5.5 meters (18 feet). The amount of inflow to the reservoir through direct precipitation and stream runoff is important to the dissipation of waste heat and the dilution of chemical elements which result from power plant operation. Long-term records indicate inflow and outflow vary greatly on a seasonal and annual basis (Volume II). Comparison of 1979 and 1980 data with average values indicate that neither year can be considered typical for precipitation and runoff into the reservoir.

Flow characteristics of streams providing inflow to the reservoir are shown in Table 1 and Figures 3 and 4. Total inflow to the reservoir has a long-term average of 212 cubic feet per second (cfs) and retention time of approximately six months, while the flows during 1979 and 1980 were 362 cfs (retention time, four months), and 147 cfs (retention time, 9.5 months), respectively. The only regulation of streamflow upstream of Hyco Reservoir is for a water supply reservoir on South Hyco Creek operated by the city of Roxboro. There were no withdrawals from the South Hyco Creek basin for water supply during the study period of 1979 and 1980.

3.0 THE ROXBORO STEAM ELECTRIC PLANT

The RSEP is composed of four coal-fired units having a total maximum output capacity of approximately 2,500 MWe (Figure 5). Units 1 and 2 began operation in 1966 and 1968, respectively, and operate in a once-through cooling mode. Unit 3 was placed on line in 1973 and used only on once-through cooling until 1976 when it began operating on mechanical draft cooling towers. Unit 4 has operated on mechanical draft closed-cycle cooling towers since it was placed in commercial operation in September 1980.

The locations of the intake and discharge systems for the plant have been changed from the original design due to the addition of Unit 3. The original intake utilized a "skimmer wall" near midreservoir to draw deeper cooler water into the cooling systems of Units 1 and 2. The original discharge for Units 1 and 2 entered the reservoir approximately 2,500 feet east of the confluence of the North Hyco and South Hyco Creek arms; this is the current location of the discharge. Units 1 and 2 require approximately 865 cfs of cooling water. When Unit 3 became operational, it required an additional 780 cfs of cooling water, making the total cooling water flow approximately 1,645 cfs.

When Unit 3 was placed on line in 1973, the discharge cooling water flow path was modified to utilize more of the reservoir surface area for cooling. The intake canal was moved to a point near the main dam; the discharge canal was extended and divided to provide two points of discharge, one in the South Hyco Creek arm and the other in the Cobbs Creek-North Hyco Creek arms. The Cobbs Creek branch was utilized to carry the portion of discharge to the North Hyco Creek branch and a new flood spillway was provided at Cobbs Creek. These modifications increased the available cooling surface area of Hyco Reservoir from approximately 2,800 acres to approximately 4,000 acres. With this discharge configuration, approximately 30% of the thermal discharge was directed to the South Hyco area and 70% to the Cobbs Creek-North Hyco area.

In late 1976 Unit 3 began operating on mechanical draft cooling towers, and the discharge for Units 1 and 2 was switched back to its original location on the main body of the reservoir to satisfy an order of the North Carolina Environmental Management Commission. Discharge water from cooling towers serving Unit 3 is directed into the intake forebay of Units 1, 2, and 3. Unit 4 removes makeup water for its cooling towers from the discharge basin at a maximum rate of approximately 13 cfs. During blowdown an additional 11 cfs is required. Units 1 and 2 ash pond effluents flow into the intake canal and Units 3 and 4 ash pond effluents flow into the discharge basin. Therefore, the ash pond and cooling water discharges of RSEP enter the main reservoir at a common point.

4.0 SAMPLING STATIONS

Sampling stations and frequency of sampling for thermal and dye tracer studies are described in Volume II. The stations were selected to provide sites for continuous recordings of Hyco Reservoir temperatures and for intensive studies of temperature profiles during 1979 and 1980 (Figure 5a). Sampling stations for biological and chemical investigations are shown on Figure 1 and, as in thermal and dye tracer studies, were chosen to reflect plant affected and control areas of the reservoir created by the present intake and discharge configurations.

Transect 2 of the biological and chemical program is located upstream of the plant where the reservoir is principally influenced by the source water of North Hyco Creek. Transect 3 is located in an arm of the reservoir near the source water

in abundance and standing crop between 1979 and 1980 occurred at all transects, it would not appear that the trend was associated with thermal effects (Volume III, Section 7.2.2).

The intake structure for RSEP Units 1, 2, and 3 is isolated from the main reservoir by a long canal and an intake forebay. As a result, the fishes in the intake area act independently of the reservoir fishes. This is seen when entrainment rates and reservoir larval fish catches are compared. While larval fish catches decreased in the reservoir from 1979 to 1980, no change was observed in entrainment rates during the same period. The low impingement and entrainment rates measured at Hyco Reservoir have little impact on fisheries.

Sportfish populations are generally comparable to those of other reservoirs with the exception of largemouth bass. Data collected since 1978 indicate that the largemouth bass population may be improving as shown by increased catches, wider distribution, and increased numbers of young-of-year each year (Figures 33 and 34). In general, fishes in Hyco Reservoir appear to have satisfactory growth rates in comparison to other reservoirs (Table 5). However, growth of largemouth bass in Hyco Reservoir is comparable during the first year and is slower during subsequent years. Conclusions concerning largemouth bass are based on small numbers of fish. Therefore, these conclusions may change when additional data are collected.

7.0 SUMMARY & CONCLUSION

Few environmental studies were conducted at Hyco Reservoir prior to 1978. The results of intensive studies performed during 1979 and 1980 have provided insight into the physical, chemical, and biological regimes currently found in the reservoir. Physical measurements provided detailed information on thermal plume extent and movement and on dissolved oxygen gradients for both a high-flow and a low-flow year. Ambient water temperatures were approximately 30°C (86°F) during both years of study. The highest monthly average discharge temperature during 1979 was 40.6°C (105°F) and during 1980 was 43.4°C (110°F). There was a rapid dissipation of heat from the discharge area in vertical and horizontal directions. Temperature at the discharge returned to 30°C (approximate summer ambient) within the upper four meters (13 feet) of water representing 30% of the total volume of the reservoir. Hot spots do not exist outside the immediate discharge area.

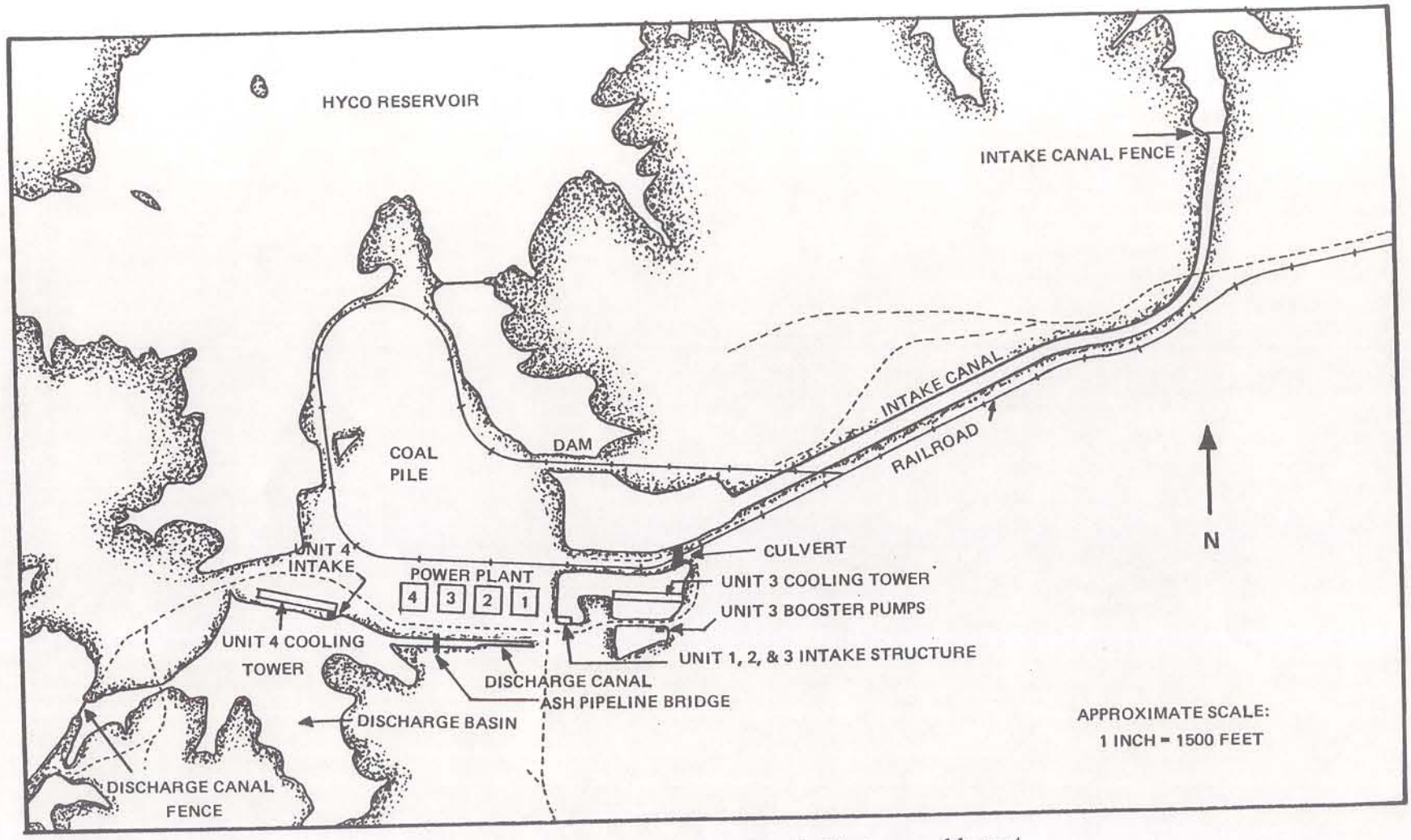

Figure 5. Roxboro Steam Electric Plant general layout.

HYCO RESERVOIR ENVIRONMENTAL REPORT 1979-1980

Volume III
Biological and Chemical Studies

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adult crappie following spawning. Both of these explanations are feasible in Hyco Reservoir. A decrease in the numbers of small gizzard shad available as prey was observed during 1980. This is seen in a decrease in numbers of gizzard shad in rotenone samples and an increase in the average weight of gizzard shad from 1979 to 1980 (Tables 7.7 and 7.8). The average weight of gizzard shad in rotenone samples increased from an average of 14.4 grams per fish in 1979 to 23.6 grams in 1980. The increase in size was observed at all transects, including Transect 3.

Unexplained die-offs of crappie have occurred during past years. However, during the fall of 1980, the numbers of crappie, particularly small crappie, increased in gill net and electrofishing catches. This apparent increase in numbers of crappie in Hyco Reservoir supports the cyclic theory of crappie populations.

7.6 Entrainment

Entrainment on Unit 3 was measured biweekly beginning in March 1979 and continuing through December 1980. Ichthyoplankton nets (0.5 m, 571 μ mesh) were lowered into the water on a frame placing them in the path of water drawn into Unit 3 for a known time (1-4 hours). Replicate samples were collected during daylight and after dark. The organisms were removed from the net and preserved in buffered formalin for later identification, enumeration, and measurement in the laboratory.

Entrainment catches adjusted to a standard volume (1000 m^3) were low (Tables 7.18 and 7.19). The highest entrainment rate recorded was 57 fish larvae per 1000 m^3 during the night sample on May 7,1980. The next highest entrainment was 36 fish per 1000 m^3 on the night of May 22, 1979. Entrainment was limited to gizzard shad, unidentified shiners, Lepomis spp., unidentified fish larvae, and unidentified fish eggs. Ichthyoplankton was found in only 12 of the 77 (16%) samples collected.

Intake velocities at Unit 3 are intermediate between those measured at Units 1 and 2 (Table 7.20). Average intake velocities are 0.868, 0.781, and 0.827 feet per second for Units 1, 2, and 3, respectively. Therefore, ichthyoplankton entrainment rates (number per 1000 m^3) on Unit 2 are expected to be slightly less than those measured on Unit 3. Entrainment rates on Unit 1 would be slightly greater.

An analysis of variance on the log transformation of total catch rate showed a significant difference between sampling periods. Catches were higher at night than during the day. No significant difference was found between years.

Mean entrainment rates of 1.8 fishes per 1000 m^3 in 1979 and 1.7 fishes per 1000 m^3 in 1980 measured on Unit 3 are much lower than mean catches of 162 fish per 1000 m^3 in 1979 and 33 fish per 1000 m^3 in 1980 made with ichthyoplankton push nets in the reservoir (Table 7.13).

The intake structure for RSEP Units 1, 2, and 3 is isolated from the main reservoir by a long intake canal and an intake forebay. As a result, the fishes in the intake area act independently of the reservoir fishes. This is seen in the above comparison of entrainment rates and reservoir larval fish catches. While larval fish catches decreased more than 80% in the reservoir from 1979 to 1980, no change was observed in entrainment rates during the same period.

Since entrainment appears largely limited to fishes within the intake canal and intake forebay and entrainment rates are very low, entrainment at the Roxboro Steam Electric Plant has little, if any, adverse impact on the Hyco Reservoir fishery.

7.7 Impingement

Impingement was measured for Roxboro Units 1 and 2 biweekly beginning in May 1979. Because Unit 3 has no screens, no impingement is possible on that unit. During most months sampled, both numbers and weights of fishes impinged per 24 hours were low (below 50 fishes per 24 hours). However, higher impingement rates were observed during September and November 1979 for both Unit 1 and Unit 2 (Table 7.21). Higher impingement rates were also observed in 1980 for Unit 1 from January through April and during February for Unit 2 (Table 7.22). The increased impingement during the winter is attributable to one species--gizzard shad. Intake water temperatures were measured when impingement samples were taken. These data are shown in Figure 7.28. Comparison of impingement data (Tables 7.21 and 7.22) with these temperature data shows that gizzard shad impingement increased as water temperatures decreased. Increased impingement of this species as a result of cold stress is common at cooling water intakes.

During the months of highest impingement (September 1979, November 1979, and March-April 1980), an average of 93% of the fishes impinged on Unit 1 and 89% of the fishes impinged on Unit 2 were gizzard shad. The second most frequently impinged fish on both units was bluegill. Bluegill impingement was greater than that of gizzard shad on both units during May, June, July, and October of 1979 and May and December of 1980, but total numbers were relatively low.

Since impingement is very low and, like entrainment, is limited to fishes living in the intake canal and intake forebay, impingement is not a problem at Hyco Reservoir.

7.8 Age and Growth

During 1979 and 1980 scale samples were taken from bluegill, largemouth bass, and black crappie and spines were taken from channel catfish. The scales and spines were analyzed to determine age and growth rates of these species for comparisons with Hyco Reservoir data collected in previous years and with data from similar reservoirs in other areas.

For each species, total lengths were calculated at each age. These lengths were calculated using the relationship $L = a + cS$, where L is the calculated total length, S is the scale measurement, and a and c are constants determined from the least-squares regression of total length plotted against the projected scale radius. Where available, data collected from Hyco Reservoir fishes during earlier sample years are reported for comparison. With the exception of largemouth bass, data from small sample sizes are not reported.

7.8.1 Bluegill

The weighted means of the calculated total length (in millimeters) at each age for bluegill collected at Hyco Reservoir during 1976, 1979, and 1980 are shown on the following page.

Table 7.13 Mean abundance and range for larval fishes collected in Hyco Reservoir during 1979 and 1980 by transect and month.

	Month	Transects 2 1979	2 1980	3 1979	3 1980	4 1979	4 1980	5 1979	5 1980	9 1979	9 1980	All 1979	All 1980
*	January	0	0	0	0	0	0	0	0	0	0	0	0
	February	0	0	0	0	0	0	0	0	0	0	0	0
**	March	1(0-18)	0	9(0-58)	0	0	1(0-18)	0	1(0-15)	0	1(0-19)	2	1
***	April	41(0-278)	29(0-295)	184(0-1378)	78(0-347)	19(0-73)	32(0-209)	15(0-130)	28(0-356)	21(0-91)	32(0-219)	56	40
	May	1121(0-4364)	25(0-156)	1725(89-9835)	92(0-552)	224(0-1657)	60(0-740)	397(0-3393)	24(0-315)	625(15-2436)	29(0-265)	823	46
	June	164(0-665)	29(0-198)	413(0-2048)	526(0-2185)	110(0-425)	18(0-112)	76(0-460)	43(0-385)	184(0-1157)	11(0-81)	189	120
	July	7(0-67)	23(0-311)	40(0-347)	19(0-113)	29(0-317)	1(0-20)	13(0-135)	26(0-429)	4(0-65)	4(0-41)	19	15
	August	2(0-17)	4(0-98)	11(0-85)	9(0-84)	0	0	2(0-20)	7(0-150)	2(0-22)	1(0-17)	4	4
**	September	8(0-54)	22(0-170)	8(0-19)	1(0-17)	0	0	2(0-30)	4(0-44)	1(0-16)	6(0-47)	4	7
	October	2(0-14)	0	0	0	0	0	0	4(0-17)	0	0	<1	1
*	November	0	0	0	0	0	0	0	0	0	0	0	0
	December	0	0	0	0	0	0	0	0	0	0	0	0
All months		200	18	352	102	56	15	76	19	124	11	162	33

*Monthly sampling

**Bimonthly sampling

***Weekly sampling

Values are given in #/1,000 m^3 with the range in parenthesis.

Table 7.18 Ichthyoplankton collected from Roxboro Steam Electric Plant Unit 3 intake water during 1979.

	Number Entrained per 1000 m^3 with 1/2 m 571 μ mesh net (values represent mean of replicate (2) samples)																																			
	3/26		4/10		4/23		5/7-8		5/22		6/4-5		6/19		7/2-3		7/16-17		7/30-31		8/13-14		8/27-28		9/14		9/24 - 12/3		12/10		12/17	
	D	N	D	N	D	N	D	N	D	N	D	N	D	N	D	N	D	N	D	N	D	N	D	N	D	N	D	N	D	N	D	N	D	N	D	N
Gizzard shad							1	2	1	5		1																								
Unidentified shiner										5		2																								
Lepomis spp.							1			26	2						2																			
Unidentified larvae						1																														
Unidentified fish eggs									1																											
TOTAL	0	0	0	0	0	1	2	2	2	36	2	3	0	0	0	0	2		0	0		0	0		0	0		0	0	0	*		*	0	0	0	0

*No sample (Unit 3 out of service)
D - Day samples
N - Night samples

Table 7.19 Ichthyoplankton collected from Roxboro Steam Electric Plant Unit 3 intake water during 1980.

	Number Entrained per 1000 m^3 with 1/2 m 571µ mesh net (values represent mean of replicate(s))																							
	1/3		1/15		1/29		2/12		2/26		3/25-26		4/8-9		4/21-22		5/7-8		6/2-3		6/16-17		6/30	
	D	N	D	N	D	N	D	N	D	N	D	N	D	N	D	N	D	N	D	N	D	N	D	N
Gizzard shad															6		1	57						
Golden shiner																					1			
Unidentified larvae																					12			
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	1	57	0	0	0	13	0	0

	Number Entrained per 1000 m^3 with 1/2 m 571µ mesh net (values represent mean of replicate)s)																							
	7/14-15		7/28-29		8/12-13		8/25-26		9/8-11		9/23-24		10/6-8		10/20		11/4		11/19-20		12/1-3		12/16-17	
	D	N	D	N	D	N	D	N	D	N	D	N	D	N	D	N	D	N	D	N	D	N	D	N
Gizzard shad																								
Golden shiner																								
Unidentified larvae																								
Total	0	0	0	0	0	0	0	0	0	0	0	0	*	*	0	*	0	0	0	0	0	0	0	0

* No sample

D - Day samples

N - Night samples

Table 7.20 Average intake velocities at Roxboro Steam Electric Plant on July 13, 1979.

	Velocity (ft/sec)
Unit 1	
Bay 1	0.851
Bay 2	0.884
Average	0.868
Unit 2	
Bay 3	0.810
Bay 4	0.739
Bay 5	0.793
Average	0.781
Unit 3	
Bay 6	0.803
Bay 7	0.831
Bay 8	0.841
Average	0.827

Calculated from data collected by CP&L Civil Unit (Fossil Plant Engineering and Construction Department).
Velocities are an average of measurements taken at 3-foot intervals from surface to bottom.

Table 7.21 Fishes impinged on the Roxboro Steam Electric Plant intake screens, May-December 1979.

	(Average number and weight per 24 hours for each month)															
	May (n=1)		June (n=2)		July (n=3)		August (n=2)		September (n=2)		October (n=2)		November (n=2)		December (n=2)	
	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
Unit 1 (2 pumps)																
Gizzard shad					1.0	2	1.0	15	71.6	217	4.3	21	545.1	1640	17.8	64
Golden shiner													0.5	5	0.5	5
White catfish			0.5	7	0.7	174	0.5	42	0.5	175	0.7	24				
Channel catfish					0.3	23									0.5	478
Striped bass													0.5	19		
Green sunfish									1.6	68	0.6	11	1.1	13	1.0	7
Bluegill	4.4	181	1.0	13					2.2	18	5.9	136	7.4	230	0.5	2
Black crappie									0.5	3	0.6	5	1.0	2		
Yellow perch									0.5	2						
Total	4.4	181	1.5	20	2.0	199	1.6	57	76.9	423	12.1	197	555.7	1908	20.2	558
Unit 2 (3 pumps)																
Gizzard shad			0.5	40					158.7	595	2.6	30	84.0	280	12.2*	49*
Golden shiner					0.3	2					0.3	3				
White catfish			0.5	2					0.5	34	1.0	210	1.0	585	0.8*	32*
Channel catfish									1.1	341						
Green sunfish			0.5	6	0.3	4	0.5	3	0.5	2	1.0	11				
Bluegill	2.2	61	1.6	60	0.3	7			8.1	92	8.5	163	6.0	144	1.8*	79*
Black crappie											0.3	1				
Yellow perch							0.5	2			0.7	2				
Total	2.2	61	3.1	108	0.9	13	1.0	5	168.9	1064	14.4	420	91.0	1009	14.8*	160*

NOTE: Weights are in grams.

n = Number of samples.

*Values represent total impingement from one sample with two pumps operating and one sample with three pumps operating.

Table 7.22 Fishes impinged on the Roxboro Steam Electric Plant intake screens during 1980.

	Average number and weight (in grams) per 24 hours for each month																							
	Jan.(n=3)*		Feb.(n=1)**		Mar.(n=2)*		Apr.(n=2)*		May(n=2)		Jun.(n=2)		Jul.(n=3)		Aug.(n=2)		Sept.(n=2)		Oct.(n=2)*		Nov.(n=2)		Dec.(n=2)*	
	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
Unit 1 (2 pumps)																								
Gizzard shad	187.9	631	1105.3	3862	500.0	1630	207.4	734			3.8	13					3.5	53	9.7	114	9.0	112	5.0	74
Golden shiner							1.1	6							0.5	8			0.8	10				
Satinfin shiner					0.9	2	0.6	2	0.6	1											1.5	7	1.0	3
White catfish			1.1	238							0.5	116	0.7	234					1.8	328				
Channel catfish																	0.5	302			0.5	39		
Green sunfish	0.9	14	3.2	10	1.3	4	5.1	26	0.6	5	0.5	9	0.4	5	1.1	6	6.7	39	23.9	195	7.5	51	8.5	64
Bluegill	1.6	42	3.2	91	0.5	15	70.8	1509	2.9	86	1.1	19	1.4	24	0.5	2	2.8	44	9.0	188	4.0	34	4.5	87
Black crappie	0.3	6	1.1	3									0.3	3	0.5	5			0.5	9				
White crappie							0.6	2																
Yellow perch							8.0	46	0.6	4														
Total	190.8	693	1113.9	4204	502.8	1652	293.6	2325	4.6	95	5.9	158	2.8	266	2.6	21	13.6	438	45.7	845	22.5	243	19.2	228
Unit 2 (3 pumps)																								
Gizzard shad	25.8	100	383.4	1375	5.0	10	7.0	22			0.5	3	0.3	5	0.5	5	0.5	11			3.5	46	3.0	18
Golden shiner																					0.5	7		
Satinfin shiner																					2.0	8		
White catfish			0.5	155	1.0	271			0.6	6	0.5	75			0.5	251					1.0	15		
Green sunfish			2.1	11			1.0	18					0.3	2	1.0	4	2.3	10	1.0	10	7.5	49	4.0	27
Bluegill	0.4	7	0.5	13	1.0	25	1.0	28	0.6	26							0.6	4	2.0	13	4.0	64	3.0	25
Black crappie			0.5	143																				
Total	26.2	107	387.1	1697	6.9	305	9.0	68	1.2	32	1.0	78	0.7	7	2.1	260	3.4	24	2.0	23	18.5	189	10.0	70

*One sample on Unit 2

**Two samples on Unit 2

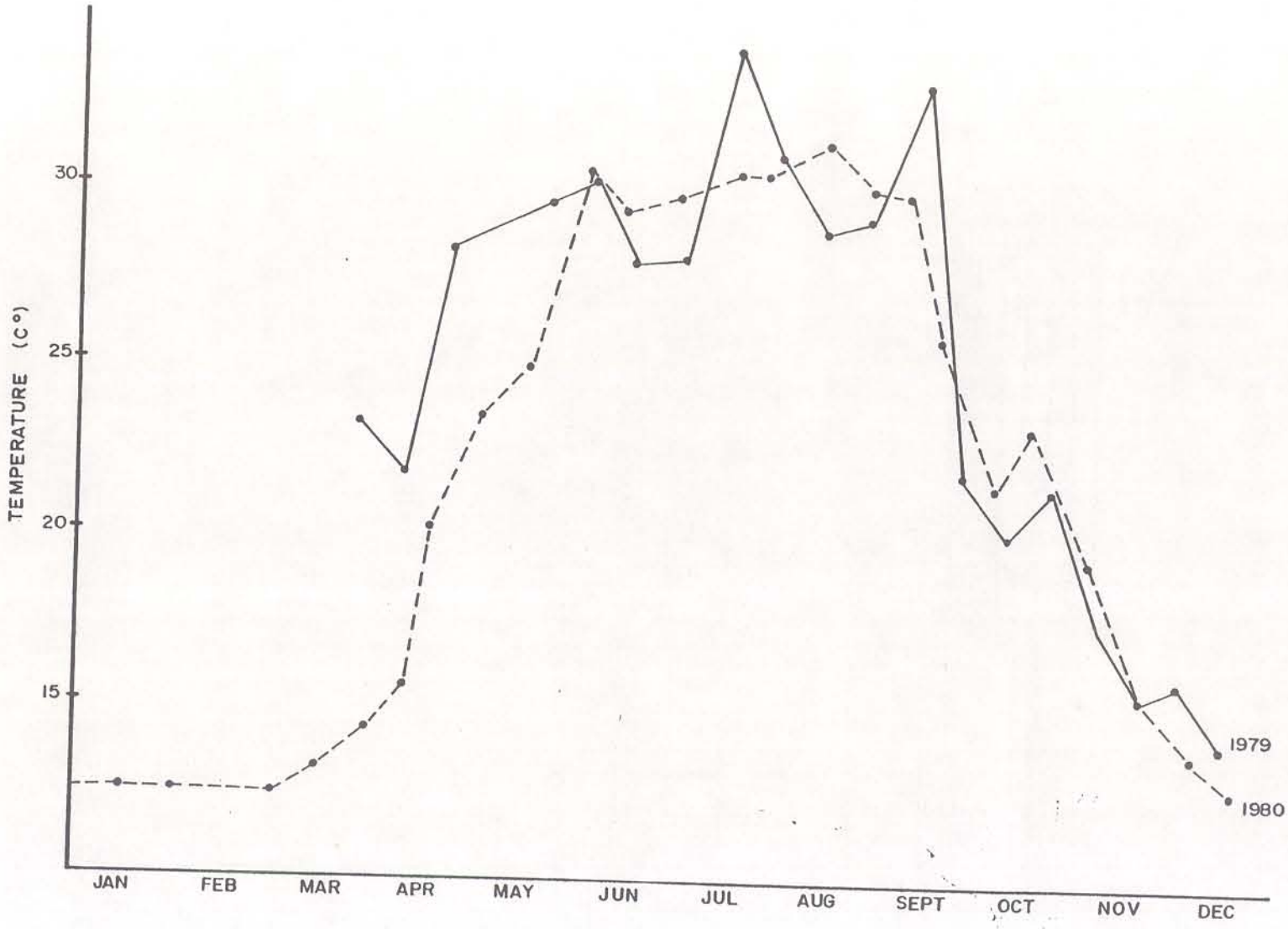

Figure 7.28 Roxboro Steam Electric Plant intake water temperatures measured during impingement sampling in 1979 and 1980.